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10/031,542	01/18/2002	Christoph Gebhardt	113737.7	6594

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EXAMINER

JOHNSTON, PHILLIP A

ART UNIT PAPER NUMBER

2881

DATE MAILED: 12/22/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/031,542	GEBHARDT ET AL.	
	Examiner	Art Unit	
	Phillip A Johnston	2881	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 22-52 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 22-52 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 January 2002 is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☒ All b) ☐ Some * c) ☐ None of:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
 a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>12/5</u> . | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

Claims Rejection – 35 U.S.C. 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,338,931 to Spangler in view of Vora, U.S. Patent No. 5,053,343, and in further view of Knauer, U.S. Patent No. 4,935,623.

Spangler (931) discloses that ion mobility spectrometry is a technology to detect and identify the presence of an ionizable chemical species, and provide quantitative information. Conventionally, such an ionizable chemical species is ionized using a radioactive source. The ionized samples, which can be positively or negatively charged, are then subject to an electrostatic field which causes the ions to migrate (spatially separated) against a counter current flow of a drift gas. Different chemical species migrate with different mobilities and arrive at an ion collector with different elapsed times. Data from such an ion collector can be stored and analyzed to provide information about the ionized chemical species in terms of the elapsed time, and the quantity of the ionizable chemical species contained in the test sample.

To further improve the sensitivity of the ion mobility spectrometer, this invention further discloses the use of a dopant (reaction partner) to be introduced into the carrier stream. The dopant to be used in this invention has an ionization potential less than the photon energy emitted by the flashlamp corresponding to the wavelength of the emitted light. With a krypton lamp, the photon energy is 10.0-10.2 eV; therefore, the dopant should have an effective ionization potential less than 10.0 eV. If an argon lamp is used (having a photon energy of 11.7 eV), other dopants with higher effective ionization potentials can be used. The use of such a dopant not only improves specificity of the ion mobility spectrometry, it also enhances sensitivity when a photoionization source is used to generate ionized samples. One reason that the dopant increases sensitivity is the result of the larger ionization cross-section provided by the dopant ions compared to photons. Ions have larger cross-sections because the electric field radiated by the ionic charge induces an opposite charge in the sample molecule (as recited in Claim 1). This induced charge causes the molecule to be attracted to and cluster with the ion to form a new product ion. Such an induced dipole interaction makes ion-molecule reactions in the gas phase among the fastest chemical reactions. It is not necessary, however, that the dopant has a true ionization potential lower than the photon energy. An excited dopant can be generated which is ionized by subsequent reactions. Therefore, the criterion for selecting a proper dopant is the "effective" ionization potential of a molecule, and is not necessarily limited to the "true" ionization potential. See Column 1, line 17-31; Column 3, line 63-68; and Column 4, line 1-25.

Spangler (931) also discloses in FIGS. 4A and 4B, results from the measurement of a trace concentration of DMMP using a continuous dc lamp and a flashlamp, respectively, as the photoionization source, when 350 parts per million of acetone is added in the carrier gas as a dopant. Without the addition of the acetone dopant, very weak or essentially no response was observed in both cases. The ions with drift times of 12.28 milliseconds (FIG. 4A) and 11.83 milliseconds (FIG. 4B) are protonated dimer ions of acetone, which act as reactant ions to ionize the DMMP molecules. The ions with drift times of 14.20 milliseconds (FIG. 4A) and 13.80 milliseconds (FIG. 4B) are mixed clusters of the protonated acetone and DMMP.

FIGS. 5A and 5B show measurement results from a trace concentration of methyl salicylate (MS) with 500 parts per million of acetone added to the carrier gas as dopant, using a continuous dc lamp and a flashlamp, respectively. The operating parameters are similar to those used to obtain results shown in FIGS. 4A and 4B, respectively, except that the ion mobility spectrometer is now used in the negative ion mode. It is to be noted that the flashlamp case showed a much better response than the dc lamp case. The ions with drift times of 10.44 milliseconds (FIG. 5A) and 10.12 milliseconds (FIG. 5B) are quasimolecular product ions of MS. The limit of detection for MS was 0.006 mg/m³, again comparable to that obtained from a ⁶³Ni radioactive ion mobility spectrometer. See Column 7, line 35-68; and Column 8, line 1-6.

Spangler (931) as applied above does not disclose the use of neutral molecules in an adsorbate coating, and transferring them to charged cluster fragments, as recited in Claim 24. However, Vora (3432) discloses in Fig. 1 an ion mobility

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spectrometer (IMS) 8 for identifying one or more constituents in a sample gas 9. A carrier gas 15 with sample gas 9 passes through inlet port 11 of housing 12 into reaction region 16. The carrier gas 15 may be, for example, a high purity gas, such as nitrogen or purified air, as well as ambient air with hydrogen, for example 0.1% to 2% H₂, with atmospheric hydrogen or without hydrogen. The atmosphere contains about 0.01% hydrogen by volume. However, no flame is necessary in carrier gas 15, as in prior art flame detectors. Sample gas 9 may be injected into the carrier gas by means of, for example, an orifice 10 shown in FIG. 1, a syringe, a membrane inlet, an injection port, a gas chromatographic column in gas chromatography. A preconcentration device, or other suitable sample delivery means dependent on the application may also be used.

Heater filament 33 is coated with an electrolyte 34. The surface 35 of the electrolyte 34 is heated by heater filament 33, which is coupled to heater supply 36 over leads 31 and 32. Heater filament 33 and electrolyte 34 is positioned in reaction region 16 to permit direct impingement of sample gas molecules 9 thereon to assure surface ionization of sample gas molecules 9 at surface 35. Heater supply 36 is isolated from ground potential through transformer 37. Transformer 37 has a first winding coupled over leads 38 and 39 to a source of power and a second winding coupled over leads 40 and 41 to heater supply 36. Lead 41 is also coupled to high voltage bias source 25 to allow the electrolytic source 34 to float at voltage V_R , the voltage applied over lead 42 to conductive ring 21, or above V_R by a voltage V_S in the range from 0 to 3000 volts. Electrolytic source 34 will have the most negative or

positive voltage of the IMS cell, depending on the polarity selected for the high voltage bias source 25.

The surface temperature of electrolytic source 34 is heated without a flame or combustion to a predetermined temperature in the range from room temperature to 1000.degree. C., depending on the electrolyte and the electric field applied to surface 35 of electrolytic source 34. The electrolytic source 34 functions to react with sample molecules 9 at or in contact with surface 35 to produce positive or negative product ions 44. Or, electrolytic source 34 functions to evaporate from surface 35 into the gas phase in reaction region 16 to react with sample molecules 9 to produce positive or negative product ions 44. Product ions 44, dependent upon the polarity of V_R , travel in the direction of the arrow 45 but are prevented from entering drift region 18 by shutter grid 17. See Column 5, line 64-68; and Column 6, line 1-29.

Therefore it would have been obvious to one of ordinary skill in the art that the ion mobility apparatus and method of Spangler (931) can be modified to use the electrolytic source in accordance with Vora (343), to provide a reaction surface for direct impingement of sample molecules.

Vora (343) also discloses in FIG. 11, a graph showing the negative ion response of the embodiment of FIG. 1. An electrolytic source 34 of Dylon-CIO cement impregnated with either cesium bromide (CsBr) or rubidium sulphate ($Rb_2 SO_4$) was used with similar results. The electrolytic source 34 was baked several weeks at low power to remove impurities from the cement. Without baking, a response was observed from phosdrin but was masked by interfering impurity peaks. In FIG. 11 the

ordinate represents negative ion current and the abscissa represents ion drift time.

Phosdrin was introduced into a purified air carrier gas 15 containing no hydrogen and flowed past electrolytic source 34, which was heated. Curve 121 shows a negative ion current at the output of detector 61 occurring at about 12.8 ms. In FIG. 11, the response to phosdrin is believed to be due to the surface reaction shown by equation (10):



where A^{\bullet} is a thermally excited alkali metal atom, rubidium, M is the sample molecule, phosdrin, A^{+} is the ionized alkali cation and M^{-} is the ionized sample molecule or a fragment thereof, as recited in Claim 30.

The surface reaction of equation (10) is believed to occur because of the low ionization potential of the alkali metals, such as cesium and rubidium. However, the reactions to produce negative ions may also be electrochemical, catalytic, thermionic, dissociative, etc. or any combination thereof. See Column 11, line 61-67; and Column 12, line 1-22.

Vora (343) further discloses that the attachment reactions as shown by equation (11) were verified by differences in mobilities of observed product ions obtained from proton attachment reactions (as recited in Claim 31) in the presence of a radioactive source and alkali attachment reactions in the presence of the alkali cation. By using an electrolytic source, the ammonium ion was not observed as shown in FIG. 13.

When using a radioactive source in an ion mobility spectrometer, ammonium

hydroxide is ionized with the formation of an ammonium ion. Further, by using a cement impregnated source, no negative ions were observed from a source of alkali salt, which was contrary to expectations. See Column 13, line 13-25.

FIGS. 24-29 are graphs showing the positive ion current from an electrolytic source, which is coated directly on heater filament 33 as shown in FIG. 3A in the embodiment of FIG. 5 without grid 76. In FIGS. 24-29 the ordinate represents positive ion current and the abscissa represents time. To obtain the data in FIGS. 24-29 heater filament 33 was coated with an electrolyte by depositing water solutions (the polar molecules of Claim 27) of electrolyte on an incandescent wire. No cement was used. The heater wire 33 along with insulator plug 28' was then inserted into reaction region 16 of ion mobility spectrometer 8" as shown in FIG. 5. In FIG. 24 curve 146 shows the positive ion current observed when lithium chloride (LiCl) was used as the electrolyte. In FIG. 25 curve 147 shows the positive ion current from potassium fluoride (KF). In FIG. 26 curve 148 shows a response from sodium chloride (NaCl). In FIG. 27 curve 149 shows a positive ion current from an electrolytic source of cesium bromide (CsBr). In FIG. 28 curve 150 shows a positive ion current from an electrolytic source of rubidium sulfate (Rb_2SO_4). In FIG. 29 curve 151 shows the positive ion current observed from an electrolytic source of ammonium nitrate (NH_4NO_3), as recited in Claims 32, and 33.

Vora(343) still further discloses in FIG. 37, a mass spectrometer 240 is shown with a sample gas 9 which may include carrier gas 15 enters housing 12 at port 11 by way of, for example, pin hole 249 and passes over electrolytic source 34. Ions 211

which may be positive or negative pass through opening 242 through electrostatic lenses 243. When ions 211 enter region 250, they travel as shown by arrow 246. During their residence in region 250, the ions 211 are mass separated by means of a magnetic field, cross RF and DC fields (quadrupole mass spectrometer), or other conventional means for separating ions according to charge/mass ratios, as recited in Claim 36.

Elements 244 and 245 of FIG. 37 are two of four rods typically used in the construction of a quadrupole mass spectrometer. After ions 211 are mass analyzed, they arrive at collector 247 which may be either a Faraday plate, a channeltron (shown in FIG. 37) or an electron multiplier. An output current is coupled over lead 252. The pressure maintained within housing 12 is in the range from 10^{-5} Torr to 10^{-9} Torr by pump 254. Pin hole (e.g. 20 micron diameter) 249 can be used to couple sample gas 9 at atmospheric pressure to the reduced pressure conditions of mass spectrometer 240. Other means for introducing sample gas 9 may be a membrane inlet, by a gas chromatograph inlet, by direct deposition on source 34 which is a part of a standard solids probe, etc. Electrolyte source 34 may be used in combination with other source of ions for example electron impact, chemical ionization, field ionization, etc. See Column 15, line 32-62.

Spangler (931) in view of Vora (343) as applied above does not disclose expansion of a gas by means of a nozzle arrangement, as recited in Claim 34. However, Knauer (623) discloses in Fig. 1, an atom beam production apparatus 10

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that includes a cluster source 12, which produces a cluster beam 14. The cluster beam 14 includes clusters of loosely bound atoms and unclustered single atoms, collectively termed particles herein, with the distribution of atoms and clusters determined by the construction of the source and the type of atoms produced. The velocities of the clusters and atoms are generally uniform, because of the manner in which the source operates.

In one type of source, atoms are heated in a crucible and emitted from an opening in the top of the crucible. A fraction of the atoms naturally cluster together, but the clustering efficiency of this type of source is low. In another type of source 12 illustrated in FIG. 1, clusters are formed by passing a pressurized gas of volatile atoms to be clustered, through a sonic or supersonic nozzle 16. Clusters are formed when the gas expands and cools. The velocity of the atoms and clusters is relatively uniform upon ejection from the nozzle 16. See Column 3, line 52-68; and Column 4, line 1-3

Knauer (623) also discloses that to establish the atom beam current of the beam 68, the apparatus was operated at an accelerating voltage of 10,000 volts, and produced argon clusters of about 2800 atoms per cluster. The incident angle α was 10 degrees, and the angle β was 6 degrees. The energy per atom in the forwardly scattered beam was about 3.5 electron volts. The atom flux of neutral atoms was equivalent to a beam current of about 2 milliamps, with a flux density at 10 centimeters from the plate 60 equivalent to about 0.2 milliamps per square centimeter. By comparison, the flux density of a conventional ion beam at this same energy per atom would have been only about 10^{-5} milliamps per square centimeter, due to space

charge effects that spread the beam. See Column 7, line 63-68; and Column 8, line 1-8.

Therefore it would have been obvious to one of ordinary skill in the art that the ion mobility apparatus and method of Spangler (931) in view of Vora (343) can be modified to use a sonic or supersonic nozzle in accordance with Knauer (623), to provide a cluster beam source.

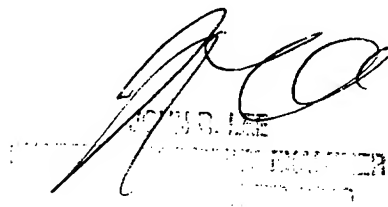
Conclusion

3. Any inquiry concerning this communication or earlier communications should be directed to Phillip Johnston whose telephone number is (703) 305-7022. The examiner can normally be reached on Monday-Friday from 7:30 am to 4:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiners supervisor John Lee can be reached at (703) 308-4116. The fax phone numbers are (703) 872-9318 for regular response activity, and (703) 872-9319 for after-final responses. In addition the customer service fax number is (703) 872- 9317.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

PJ

December 3, 2003



PHILLIP JOHNSTON
Examiner